BUILDING A METRIC

Shakira Spencer
Kennedy Space Center
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Reviewed by NASA-USRP Mentor
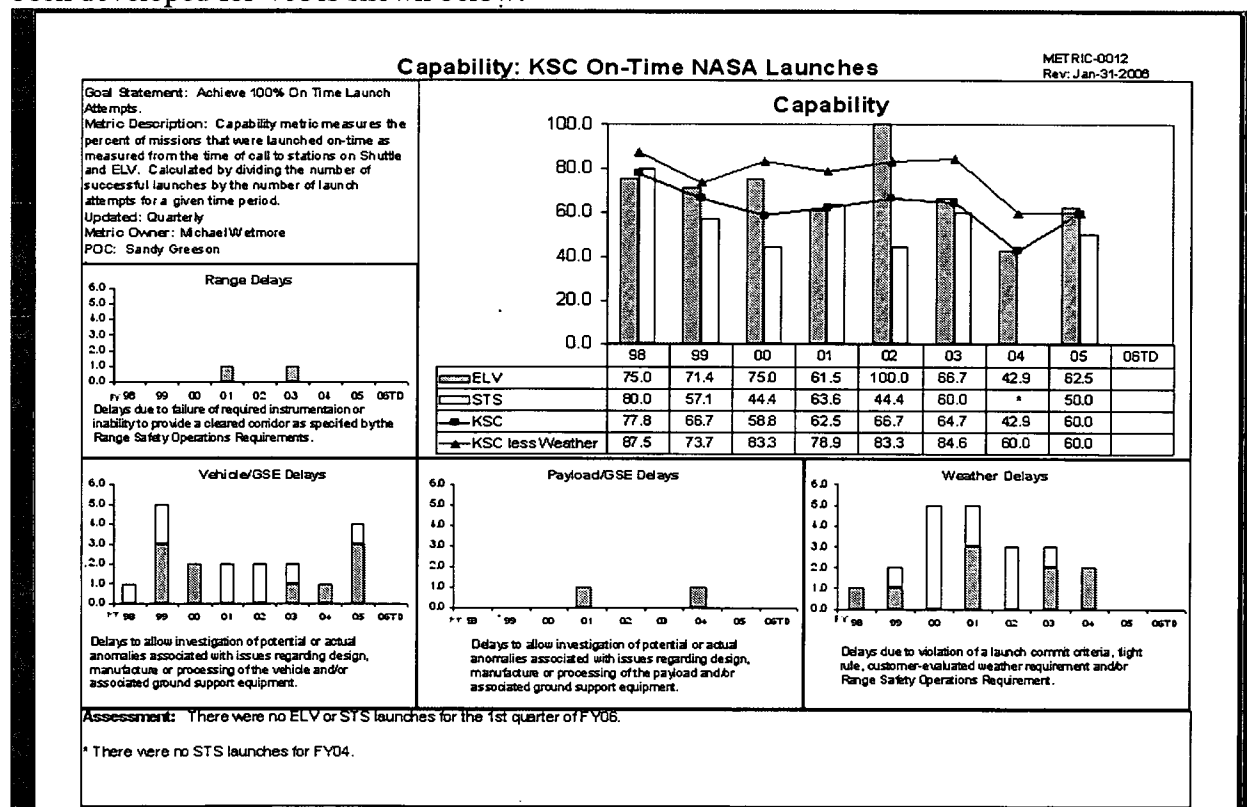Omar Baez
Launch Services Program

Abstract

Launch Services Program is a Kennedy Space Center based program whose job it is to undertake all the necessary roles required to successfully launch Expendable Launch Vehicles. This project was designed to help Launch Services Program accurately report how successful they have been at launching missions on time or +/- 2 days from the scheduled launch date and also if they weren't successful, why. This information will be displayed in the form of a metric, which answers these questions in a clear and accurate way.

On July 29, 1957 President Dwight D. Eisenhower created the National Aeronautics and Space Administration (NASA) with the signing of the National Aeronautics and Space Administration Act, which stated NASA's purpose in the preamble simply as "to provide for research into the problems of flight within and outside the Earth's atmosphere and for other Purpose." Through the decades NASA has done the necessary to more than fulfill these goals, and others that have been set before them. The men and women of NASA are taking on endeavors and accepting challenges that were thought to be humanly impossible.

NASA's success is in large part due to its vast network of centers. Each of NASA's ten centers brings something different to the organization and is instrumental in the continuing growth of NASA.

Kennedy Space Center (KSC) is described as "America's gateway to the universe – leading the world in preparing and launching missions around the earth and beyond." KSC is unique for various reasons. One of those unique capabilities is that since October 1998, KSC has had the responsibility of overseeing overall integration, engineering and launch ops for the Expendable Launch Vehicles in the Launch Services Program (VA). This is unique in that it is totally opposite of the Shuttle Program whose overall integration, launch ops, engineering and orbiter responsibilities are split up amongst Marshall Space Flight Center and Johnson and Kennedy Space Center. Launch Services Program takes on many roles and responsibilities with a mission of leadership and expertise in providing on-orbit, on-time, on cost launch services. There are many ways of determining whether or not this mission is being fulfilled. A useful way of measuring how this program is doing is through the use of a metric. The existing metric that has been developed for VA is shown below:

Capability: KSC On-Time NASA Launches

METRIC-0012
Rev: Jan-31-2006

Goal Statement: Achieve 100% On Time Launch Attempts.

Metric Description: Capability metric measures the percent of missions that were launched on-time as measured from the time of call to stations on Shuttle and ELV. Calculated by dividing the number of successful launches by the number of launch attempts for a given time period.
Updated: Quarterly
Metric Owner: Michael Wetmore
POC: Sandy Greeson

Capability

	98	99	00	01	02	03	04	05	06TD
ELV	75.0	71.4	75.0	61.5	100.0	66.7	42.9	62.5	
STS	80.0	57.1	44.4	63.6	44.4	60.0	*	50.0	
KSC	77.8	66.7	58.8	62.5	66.7	64.7	42.9	60.0	
KSC less Weather	87.5	73.7	83.3	78.9	83.3	84.6	60.0	60.0	

Range Delays

Delays due to failure of required instrumentation or inability to provide a cleared corridor as specified by the Range Safety Operations Requirements.

Vehicle/GSE Delays

Delays to allow investigation of potential or actual anomalies associated with issues regarding design, manufacture or processing of the vehicle and/or associated ground support equipment.

Payload/GSE Delays

Delays to allow investigation of potential or actual anomalies associated with issues regarding design, manufacture or processing of the payload and/or associated ground support equipment.

Weather Delays

Delays due to violation of a launch commit criteria, tight rule, customer-evaluated weather requirement and/or Range Safety Operations Requirement.

Assessment: There were no ELV or STS launches for the 1st quarter of FY06.

* There were no STS launches for FY04.

The previously shown metric displays VA's history of on time launches and the types of delays that may have caused the launches to not occur on time. Although this metric accurately tracks

delays that caused slips in the launch, it only accounted for delays that took place once the mission management team arrived and situated themselves at the launch console. However, it was often the case that there were delays prior to this milestone, that also caused the launch to slip to a later launch date. This is why a new metric had to be developed.

Although the makeup of a metric can vary depending on what's being measured, there is still a general format for displaying a metric properly. The required fields for a metric are a metric description, metric number and revision, metric title, and an assessment. The graphs that make up the metric should consists of smaller charts that serve as either historical data types or historical sources. The main chart shows the current performance. The historical charts should serve as an explanation for performance.

The process of developing this metric starts with a meeting with the Launch Directors , Omar Baez and Chuck Dovale, to see what questions they hope to answer by developing this metric, what goal they are hoping to achieve and also to determine whether or not they are attempting to measure something worthwhile and that the necessary data was available. By finding answers to these questions the metric description is also being defined. Through the meeting it was discovered that Launch Services Program had a need for a metric that tracked the launch campaign from PRE VOS, LV MRR, or SYS REV (depending on the launch service) to when the launch vehicle launched and also any delays that may have occurred during this period. The metric also needed to display what type of delay caused the vehicle to not launch on time, if this was the case. Its was important to start from PRE VOS, LV MRR, or SYS REV because this is the point from which VA initiates the launch campaign and can in some ways directly impact on time launch of the mission.

After the initial meeting with the Launch Directors, and it is understood exactly what purpose they hope this metric to serve, the working of gathering the data for the metric begins. In Launch Services case the data was in the form of ELV Launch Milestone Schedules, ELV Launch Milestones, and Flight Planning Board Direction –Configuration Control. These documents were gathered for the missions that took place from 2006 to the present date. Extracting the useful data is a matter of first organizing the documents into a system that you can track each launch campaign and if any delays were present, pinpoint why they occurred. Having the accessible data is an instrumental part in being able to develop a metric.

Once the data is gathered it's determined what charts need to be displayed as part of the metric. In this situation because the types of delays are leading indicators of slips in the launch, bar graphs were used to show how many of each types of delay, occurred for each mission. Each delay was classified as a Range, Vehicle/GSE, Payload/GSE, Weather, and Telemetry Support Delays. Although these delays aren't all reflective of Launch Services Program, these delays directly impact the launch campaign and account for any slips from the scheduled launch date. The main graph is a planned vs. actual line graphs of the missions that occurred starting from 2006, it was useful in depicting whether or not the certain milestones were met on-time.

After realizing all the necessary elements that need to go into producing a useful metric, it is also important to keep in mind that this metric is going to be a document that is updated on a regular basis. The data that goes into producing a metric must be entered in a way that it can be updated, without having to change the overall metric to fit the information. If the procedures are followed properly then the metric serves as a simple way of monitoring performance. The metric that was developed for Launch Services Program will hopefully be of great use sometime in the near future.

Goal Statement: Execute Successful Launch Campaign for All VA missions and to achieve a minimum success rate of 50%.
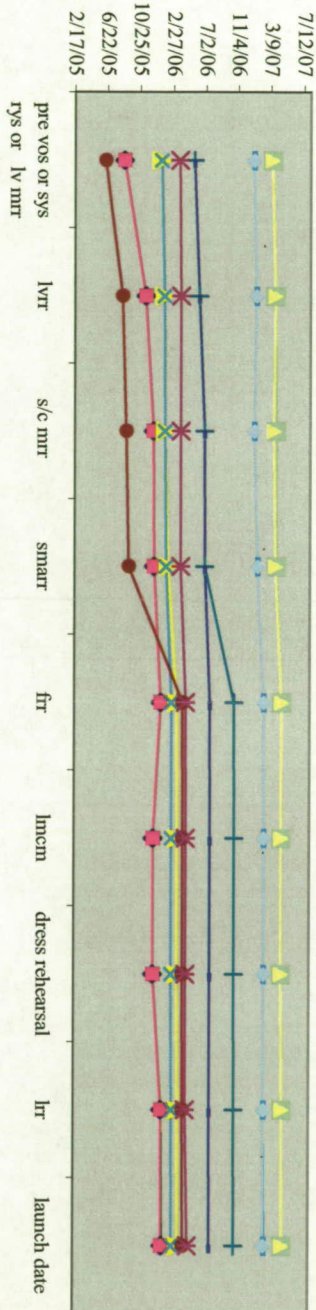
Metric Description: A successful execution of a launch campaign is launching +/- 2 days from the date set at the PreVos, SYS REV, or LV MRR meeting. This metric will track all launch delays as well as reasons for the delays, form the point of VA's involvement in the launch campaign.

Updated: Monthly

Metric Owner: Chuck Dovale

POC: Chuck Dovale

Launch Campaign

Legend:
- new horizon actual
- calipso/cloudsat planned
- themis planned
- new horizons planned
- stereo actual
- aim actual
- st-5 actual
- stereo planned
- aim planned
- st-5 planned
- themis actual
- calipso /cloudsat actual

X-axis: pre vos or sys rys or lv mrr, lvr, s/c mrr, smar, frr, lmcm, dress rehearsal, lrr, launch date

Y-axis dates: 7/12/07, 3/9/07, 11/4/06, 7/2/06, 2/27/06, 10/25/05, 6/22/05, 2/17/05

Range Delays

(bars: new horizons, st-5, calipso/cloudsat, stereo, themis, aim; scale 0.0–6.0)

Delays due to failure of required instrumentation or inability to provise a cleared corridor as specified bythe Range Safety Operations Requirements.

Weather Delays
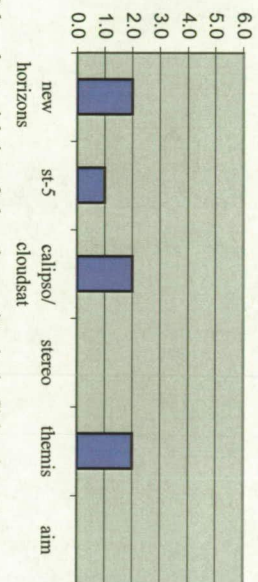
(bars; scale 0.0–6.0)

Delays due to violation of a launch commit criteria, flight rule, customer-evaluated weather requirement and/or Range Safety Operations Requirements.

Successful Launch Rates

(bars: 06, 07 TD; scale 0%–100%)

Legend:
- Success Rate
- Target Rate

Payload/GSE Delays

(bars: new horizons, st-5, calipso/cloudsat, stereo, themis, aim; scale 0.0–6.0)

Delays to allow investigation of potential or actual anomalies associated with issues regarding design, manufacture or processing of the payload and/or associated ground support equipment.

Vehicle/GSE Delays

(bars; scale 0.0–6.0)

Delays to allow investigation of potential or actual anomalies associated with issues regarding design, manufacture or processing of the vehicle and/or associated ground support equipment.

TM Support Delays

(bars; scale 0.0–6.0)
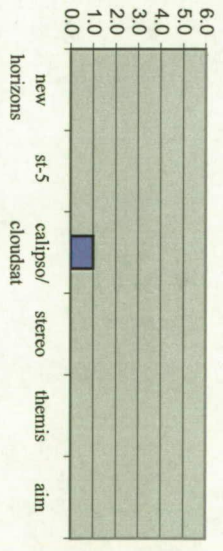
Delays due to failure of required instrumentation or inability to provide a cleared corridor as specified by the Telemetry Support Delays.

Assessment: The acutal pre vos, sys rev, or lv mrr and the lvrr date for calipso/cloudsat are actually Δ dates and could not be noted on the graph. The planned date that is listed was the first occurance of these milstones. Also, the actual and planned s/c mrr were for calipso and the s/c mrr for cloudsat was planned for 8/26/05 and it occured on 3/27/06, this too could not be listed on the graph. Calipso/cloudsat had two different s/c mrr's because they were two space crafts on the same mission.

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Goal Statement: Execute Successful Launch Campaign for All VA missions and to achieve a minimum success rate of 50%.

Metric Description: A successful execution of a launch campaign is launching +/- 2 days from the date set at the PreVos, SYS REV, or LV MRR meeting. This metric will track all launch delays as well as reasons for the delays, form the point of VA's involvement in the launch campaign.
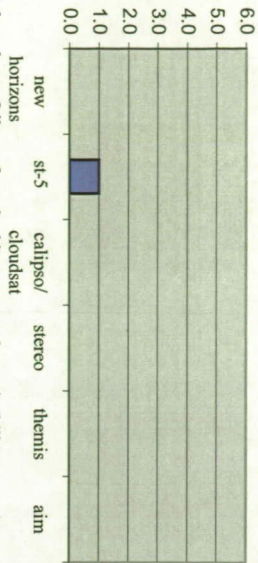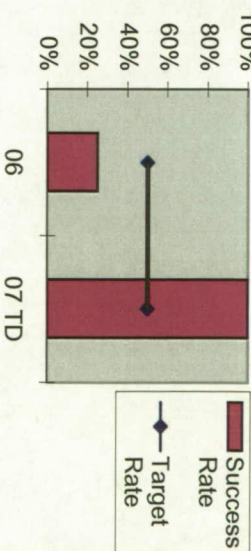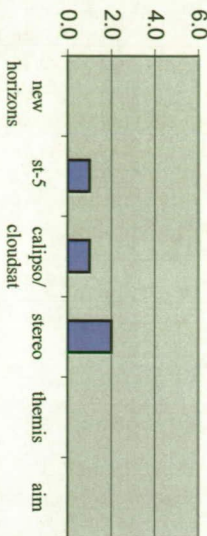
Updated: Monthly
Metric Owner: Chuck Dovale
POC: Chuck Dovale

Launch Campaign

Legend:
- pre vos or sys rvs or lv mrr
- lvr
- s/c mrr
- smarr
- frr
- lmcm
- dress rehearsal
- lrr
- launch date

- new horizon actual / new horizons planned
- calipso/cloudsat planned / stereo actual
- themis planned / stereo planned
- aim actual / aim planned
- st-5 actual / st-5 planned
- stereo actual / themis actual
- calipso/cloudsat actual

Successful Launch Rates

Legend:
- Success Rate
- Target Rate

Range Delays

Delays due to failure of required instrumentation or inability to provide a cleared corridor as specified by the Range Safety Operations Requirements.
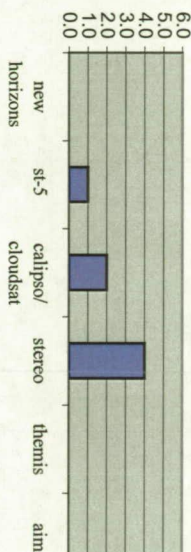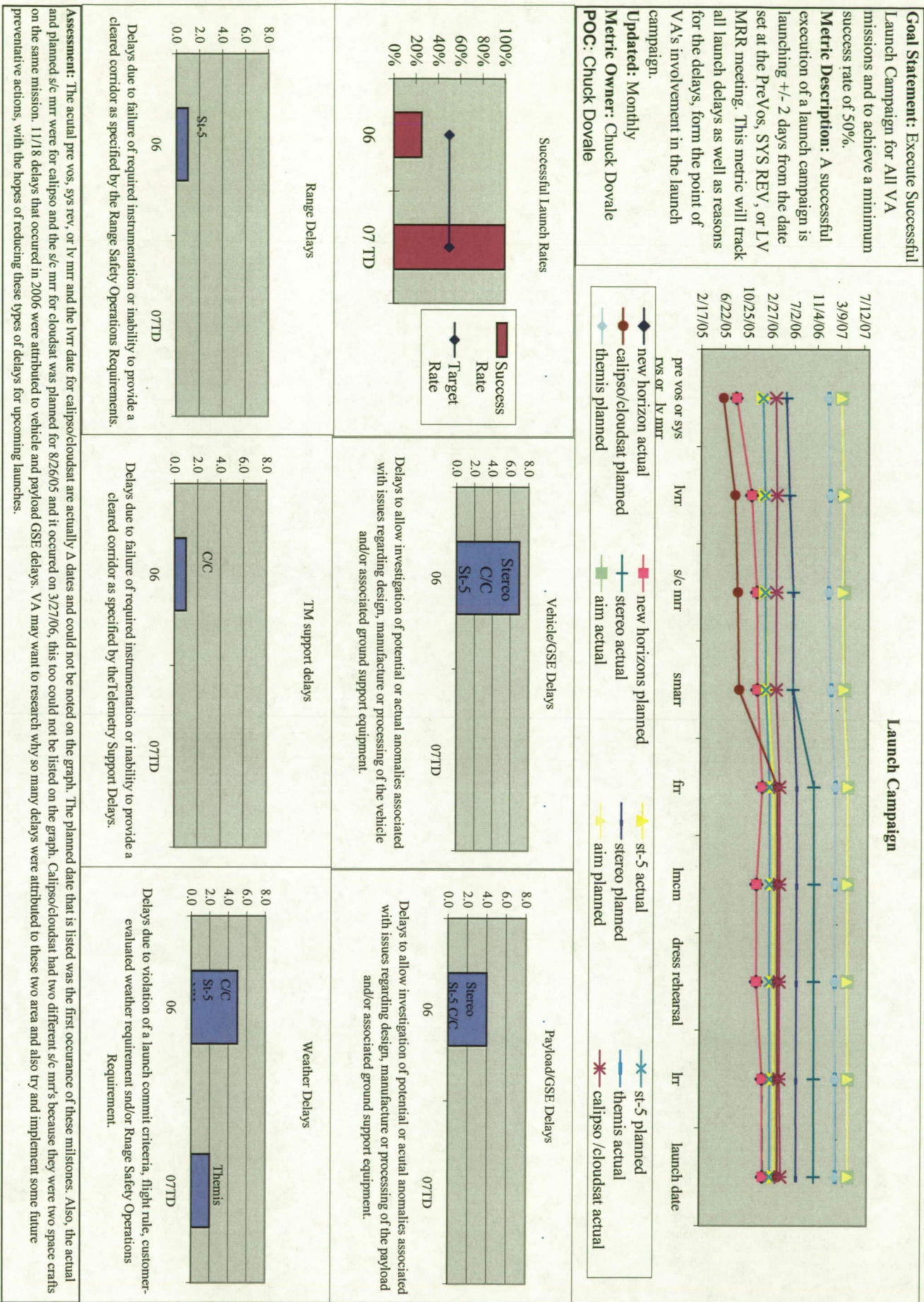
Vehicle/GSE Delays

Delays to allow investigation of potential or actual anomalies associated with issues regarding design, manufacture or processing of the vehicle and/or associated ground support equipment.

TM support delays

Delays due to failure of required instrumentation or inability to provide a cleared corridor as specified by the Telemetry Support Delays.

Payload/GSE Delays

Delays to allow investigation of potential or actual anomalies associated with issues regarding design, manufacture or processing of the payload and/or associated ground support equipment.

Weather Delays

Delays due to violation of a launch commit criteria, flight rule, customer-evaluated weather requirement snd/or Rnage Safety Operations Requirement.

Assessment: The acutal pre vos, sys rev, or lv mrr and the lvr date for calipso/cloudsat are actually Δ dates and could not be noted on the graph. The planned date that is listed was the first occurance of these milestones. Also, the actual and planned s/c mrr were for calipso and the s/c mrr for cloudsat was planned for 8/26/05 and it occured on 3/27/06, this too could not be listed on the graph. Calipso/cloudsat had two different s/c mrr's because they were two space crafts on the same mission. 11/18 delays that occured in 2006 were attributed to vehicle and payload GSE delays. VA may want to research why so many delays were attributed to these two area and also try and implement some future preventative actions, with the hopes of reducing these types of delays for upcoming launches.

Entered Data

	pre vos or sys rys or 1v mrr	lvrr	s/c mrr	smarr	frr	lmcm	dress rehearsal	lrr	launch date
new horizon actual	8/24/05	11/14/05	12/13/05	12/16/05	1/12/06	12/15/05	12/15/05	1/15/06	1/19/06
new horizons planned	8/24/05	11/14/05	12/13/05	12/16/05	1/12/06	12/15/05	12/15/05	1/15/06	1/17/06
st-5 actual	1/13/06	1/24/06	1/24/06	2/8/06	3/15/06	3/17/06	3/17/06	3/20/06	3/22/06
st-5 planned	1/13/06	1/24/06	1/27/06	1/31/06	2/22/06	2/23/06	2/23/06	2/26/06	2/28/06
calipso /cloudsat actual	03/23/06	3/28/06	3/27/06	3/27/06	4/17/06	4/18/06	4/18/06	4/19/06	4/28/06
calipso/cloudsat planned	6/13/05	8/17/05	9/1/05	9/10/05	4/5/06	4/6/06	4/6/06	4/8/06	4/10/06
stereo actual	5/18/06	6/6/06	6/27/06	6/28/06	10/21/06	10/23/06	10/23/06	10/24/06	10/25/06
stereo planned	5/18/06	6/6/06	6/27/06	6/28/06	7/19/06	7/20/06	7/20/06	7/21/06	7/22/06
themis actual	1/3/07	1/12/07	1/5/07	1/19/07	2/12/07	2/13/07	2/13/07	2/14/07	2/15/07
themis planned	1/3/07	1/12/07	1/5/07	1/19/07	2/12/07	2/13/07	2/13/07	2/15/07	2/17/07
aim actual	3/13/07	3/26/07	3/29/07	3/30/07	4/20/07	4/19/07	4/19/07	4/24/07	4/25/07
aim planned	3/13/07	3/26/07	3/21/07	3/27/07	4/20/07	4/19/07	4/19/07	4/24/07	4/25/07

	new horizons	st-5	calipso/cloudsat	stereo	themis	aim
weather delays	2	1	2	0	2	0
range delay	0	1	0	0	0	0
payload/GSE Delays	0	1	1	2	0	0
vehicle/GSE Delays	0	1	1	4	0	0
tm support delays	0	0	1	0	0	0

	06	07 TD
Success Rate	25%	100%
Target Rate	50%	50%

	06	07TD
weather delays	5	2
range delay	1	0
payload/GSE Delays	4	0
vehicle/GSE Delays	7	0
tm support delays	1	0

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References:
1. SATERN: System for Administration, Training, and Educational Resources for NASA
2. Launch Services Program: Overview Packet
3. KSC Internal Portal